

Effect of Cooperative Learning Model type Group Investigation Assisted PhET to Students' Conceptual Knowledge

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Abstract: *This research objectives are to analyze the conceptual knowledge of students on cooperative learning model type Group Investigation assisted PhET and conventional learning; To analyze the conceptual knowledge between students who have above average and below average teamwork skill; To analyze the interaction between the learning model and teamwork skill to the conceptual knowledge of the students. This is a quasi-experimental research. The sample selection was done by random class technique as much as two classes, where the first class was taught by cooperative learning model type Group Investigation assisted PhET and second class with conventional learning. The instruments used are validated conceptual test and teamwork questionnaires. The data in this research were analyzed using two-way ANAVA. The results showed that the conceptual knowledge of students using cooperative learning model type Group Investigation assisted PhET was better than conventional learning. Student's conceptual knowledge in above average teamwork skill shows better results than students with below average teamwork skill. There is an interaction between cooperative learning model type Group Investigation assisted PhET and student's teamwork skill to student conceptual knowledge. This interaction shows the students' knowledge is dominant in cooperative learning model type Group Investigation assisted PhET of students who have above average teamwork skill.*

Keywords: *Group Investigation, PhET, Teamwork Skill, Conceptual Knowledge*

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I. Introduction

Physics is a subject that is usually studied with a mathematical approach so that only learners who have high mathematical intelligence that can understand. Incorrect approach to impact on the achievement of learning outcomes that are less satisfactory, whereas physics learning is expected to be understood by each student ([1], [2], [3]). In order for the effectiveness of learning is achieved and all learners can understand the concept in the course of physics, information technology can be used.

In general, factors that affect the low quality of education in Indonesia include the problem of effectiveness, efficiency, and standardization of teaching as in [4]. Effectiveness, efficiency, and standardization of teaching that is not balanced by the teacher in the learning process to make learning does not achieve maximum results. This is included in the learning process that still uses teacher centered where the teacher as a source of learning. In the process of learning the teacher also does not use the appropriate learning model, the teacher is still the only source of knowledge for learners. In this case learning uses conventional learning ([5], [6]).

The lack of learning media is also the cause of the low learning outcomes of high school students in Pesantren Nurul Hakim. This can be seen from the conventional learning process that does not use additional media as a tool for understanding students. Learning media is essential for learning and learning outcomes that students achieve ([7], [8]). Selection of instructional media in accordance with the material also become the important aspects in learning.

Students' disinterest in following Physics learning resulted in students having low skill teamwork. The low teamwork skill is indicated by the rarity of students asking questions to the teacher and often the students do the cheating action during the exam, especially when the national exam held there is a leakage of questions. This is the biggest impact of the low skill teamwork students have.

One other cause of this low teamwork skill can be sourced from the use of conventional models, where learning is largely teacher-centered. Students with low skill teamwork tend to be more passive in the learning process. In the conventional model, students' opportunities to bring teamwork skills are very low. This causes the students have less active role in the process and the construction of knowledge in him. Students tend to only memorize facts and concepts without knowing how facts and concepts are formed. In the end, students' learning

outcomes are limited to low-thinking skills of remembering and understanding, while students' high-order thinking skills will be low because they are not activated during classroom learning activities ([9], [10], [6]).

In response to the above problems, it is necessary to have a learning model that oriented the learning on practicum and discussion activities that can create student involvement in the learning process to foster interest and understanding of the physics concept of the students. Students who learn by active learning methods, not only learn better, but also take more pleasure from the learning experience ([11], [12], [13]).

Cooperative learning model of group investigation type is a model of learning to enable students through group learning in class and conduct discussions, exchange opinions and ask questions as in [14]. This learning model is a learning model where students are active in discussing, exchanging opinions and practicing activities. The point of cooperative learning is type of group investigation with the method of learning where students struggle together in small groups to gain common knowledge. In this way, students are responsible not only for their own learning, but students are also responsible for others as in [15]. This learning model can train students in developing the understanding of the concept of Physics ([11], [12], [13]).

Cooperative learning model type Group Investigation is a learning model where students are active in discussions in heterogeneous groups, exchanging opinions and practicing activities (Hossain, 2013). Cooperative learning model type Group Investigation has constructivist theory base proposed by Piaget and Vygotsky. Constructivist is a perspective of teaching and learning in which a learner constructs meaning from experience and interaction with others and the teacher's role is to provide meaningful experiences for students. There is six steps of this model that are topic selection, cooperative planning, implementation, analysis and synthesis, presentation of final product, and evaluation [17].

The principle of reaction in cooperative learning model type Group Investigation is the teacher's role in group investigation is one of counselor, consultant, and friendly critic. Teachers must guide and reflect the group experience over three levels: the problem-solving or task level, the group management level, and the level of individual meaning. Intervention by the instructor should be minimal unless the group bogs down seriously. The support system for group investigation should be extensive and responsive to the needs of the students. The school needs to be equipped with a first-class library that provides information and opinion through a wide variety of media; it should also be able to provide access to outside resources as well. Children should be encouraged to investigate and to contact resource people beyond the school walls. One reason cooperative inquiry of this sort has been relatively rare is that the support systems were not adequate to maintain the level of inquiry. Instructional effects of this model are constructionist view of knowledge, disciplined inquiry, effective group process and governance, interpersonal warmth and affiliation. While, the nurturant effects of this model are respect of dignity of all and commitment to pluralism, independence as a learner and commitment to social inquiry [18].

Point of cooperative learning with learning methods where students struggle together in small groups to gain common knowledge. In this way, students are responsible not only for their own learning, but students are also responsible for others [19].

II. Method

The research was conducted in MAS Nurul Hakim in the Academic Year 2016/2017. The population of this research were all students in grade X in MAS Nurul Hakim that consist of 4 classes. The sample in this research were taken with random class. The sample were X A as an experimental class that used cooperative learning model type Group Investigation assisted PhET and X B as a control class that used conventional learning. Both class consist of 30 students in Physics subject. This type of research is quasi experiment using pre-test and post-test that aims to see the effect of the Group Investigation model on conceptual knowledge that distinguishes above and below average teamwork skill. Design research with 2x2 factorial design for technical analysis of two way variance (ANOVA). Data collection techniques in this research obtained through a test of conceptual knowledge and a teamwork skill questionnaire. Data collection conducted in two stages, collecting data on students' teamwork skill and collecting data on students' physics conceptual knowledge. Conceptual knowledge test used 20 multiple choice questions using five answer options. The instrument for teamwork skill was in the form of a questionnaire with 12 statements.

III. Result

Student's conceptual knowledge on control class and experiment class shown in Table 1 below.

Table 1. Pre-test and Post-test Results of Students' Conceptual Knowledge

	Conceptual Knowledge	
	Control Class	Experiment Class
Pre-test	43.0	44.3
Post-test	69.0	75.3

Based on Table 1, pre-test on control class and experiment class were 43.0 and 44.3. Post-test on control class and experiment class were 69.0 and 75.3.

1. Analysis of Conceptual Knowledge Items on Control and Experimental Class

Post-test questions of conceptual knowledge that have been answered by the students are analyzed per point. This analysis was useful to look at which student conceptual knowledge indicator becomes difficult for students.

Analysis of conceptual knowledge items each post-test item that has been given to the experimental class and control class can be seen in Table 2 below.

Table 2. Average Value of Student Answers to Each Post-test of Conceptual Knowledge in Class Control and Experiment

No	The Dimension of Conceptual Knowledge	Percentage of Achievements	
		Control	Experiment
1	Classification and Category	71.25%	78.33%
2	Principles and Generalizations	67.78%	73.33%
3	Theory, model and structure	67.22%	73.33%

Based on Table 2, the conclusions of this analysis are the percentage of students achieving the average score that correctly answers the conceptual knowledge of the students in the experimental class higher than the control class. The highest percentage of achievement for each indicator lies on the first indicator, that is classification and category, where the percentage of achievement in the experimental class is 78.33% and the control class is 71.25%. The lowest percentage of achievement for each indicator lies in the third indicators, that is theory, model and structure, where the percentage of achievement in experiment class is 73.33% and control class is 67.22%.

2. Data Analysis of Conceptual Knowledge Based on Level of Scientific Attitude

The results of conceptual physics knowledge on student post-test in control class and experiment class on above average scientific attitudes and below average were shown in Table 3 below.

Table 3. Two-Way ANOVA

Teamwork Skill \ Class	Control Class (A ₁)	Experiment Class (A ₂)	Average value
Above Average (B ₁)	68.89	78.15	75.15
Below Average (B ₂)	68.80	70.45	69.53
Average value	69.00	75.33	

Before testing the first hypothesis tested the prerequisite is the normality test, homogeneity, and test results of normal and homogeneous data distribution. After the prerequisite test, then continued with two-way ANOVA with SPSS 17.0

Table 3 shows the value of conceptual knowledge of students who were taught by using cooperative learning model type Group Investigation assisted flash media and conventional learning related to students' scientific attitude.

To be more clearly seen as the interaction will be shown in Figure 1.

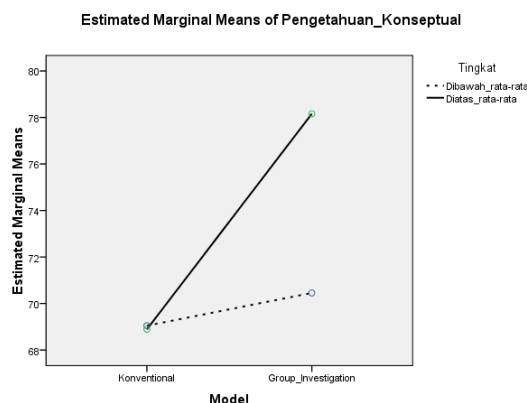


Fig. 1. Interaction of Learning Models and Teamwork Skill.

The graph shows that in the classroom which is taught by cooperative learning model type Group Investigation assisted flash media with above average scientific attitude have conceptual knowledge value better than below average scientific attitudes. In the control class, the conceptual knowledge of students who have above average scientific attitudes was similar to that of the conceptual knowledge of students who have below average scientific attitudes. The graph showed that cooperative learning model type Group Investigation assisted flash media with above average scientific attitude had a positive influence in improving students' conceptual knowledge.

IV. Discussion

1. Student's Conceptual Knowledge by Using Cooperative Learning Model Type Group Investigation Assisted PhET better than Conventional Learning

The results obtained in this research indicate that the conceptual knowledge of students with cooperative learning model type Investigation assisted PhET better than conventional learning. This was seen from the sig. value $0.005 < 0.050$ and the average value of conceptual knowledge of the experimental class is 75.3 better than the control class of 69.0. This was because the stages in the cooperative learning model type Group Investigation assisted PhET can develop students' conceptual knowledge. This was also because the cooperative learning model type Group Investigation had several advantages, among which are able to build students' ability in terms of investigating a concept by doing the lab so that students are expected to understand about the concept. The next advantage is that it can increase the level of participation in group discussions to solve problems encountered while conducting investigations. So students are trained in thinking logically about the concepts learned. This is the underlying reason why students who are taught using Group Investigation cooperative learning models are better than students who are taught by conventional learning.

In the cooperative learning model of Group Investigation type (GI) assisted PhET students were formed into several small groups consisting of four to five people. In the small group the students will interact to find answers to the problems given by the teacher. Students will find their own answers to the problems given, thus providing a real and more memorable experience for students as in [20]. In the group will also arise a compact cooperation, this makes learning fun and meaningful as in [6]. This is in accordance with the advantages of group investigation learning model, namely (1) training students to develop their thinking ability or cognitive ability by building their own information needed in the learning process, (2) to train students to grow independent thinking, (3) active student involvement from The first stage until the final stage of learning, and (4) this model makes students happy and feel enjoy the learning process as in [11]. This has resulted in the Group Investigation cooperative learning model having an effect on the conceptual knowledge of the students.

2. Student's Conceptual Knowledge Who Have Teamwork Skill Above Average is Better Than Below Average

The results obtained in this research indicate that the conceptual knowledge of students in the group of students who have above average teamwork skill better than the group of students who have below average teamwork skill. This is seen from the sig value. Of $0.045 < 0.050$ and the average value of conceptual knowledge of students in groups of students who have above average teamwork skill of 75.15 is better than the group of students who have below average teamwork skill of 69.53.

This is because in the experimental class is taught by cooperative learning model type Investigation Group assisted flash media closely related to teamwork skill, where every stages of cooperative learning model type Investigation Group assisted flash media always associated with teamwork skill. Starting from the beginning in the phase of choosing a topic, by confronting the problem of the topic to be studied, the student is already aroused to know more. Then in the cooperative planning phase, students will do the planning in terms of doing a lab work like a scientist. Furthermore, in the implementation phase, students' enthusiasm to know very much related to what happened from the experimental activities undertaken. Similarly, in the phase of analysis and synthesis, presentation of final results, as well as evaluation. These phases lead to students' curiosity because through these phases students will be able to know the results of the scientific process that has been done.

Based on the results of research ([6], [9]), teamwork skill gives a positive influence on learning achievement. The success of the Group Investigation model of cooperative learning in improving achievement and learning outcomes is made possible by the emergence of teamwork skill on students when learning with the model. In other words, cooperative learning model of Group Investigation type can grow teamwork skill.

In the process of learning when a student is not able to complete a concept will be assisted by a group of friends who already understand. When working together the social skills of students will be more prominent than working alone as in [10].

Good social skills including working in groups will make students have better learning outcomes than students with poor social skills. Good collaboration succeeds in improving learning outcomes. Cooperation

streamlines the use of time. Students who work together will keep their priorities toward the goals and work for the team's interests. Students learn skills such as communication, participation, negotiation, teamwork and presentations as in [21]. Thus, students who have above-average level of cooperation ability have higher learning outcomes than students who have below-average level of cooperation ability.

3. Interaction between Cooperative Learning Model Type Group Investigation Assisted PhET and Teamwork Skill in Influencing Conceptual Knowledge

Based on the researcher's observation, the improvement of conceptual knowledge in the experimental class is higher than the control class conceptual knowledge. This is because students in the experimental class are more active in the learning process. In the learning group the students discover the concept of the material studied along with the teacher's guidance and the help of instructional media. Discussion results are then reported in the form of worksheet that have been provided so that students can understand the concept that has been discussed.

The result of interaction test in general (Learning Group Investigation Model * Teamwork Skill) shows the interaction between the learning model used with the teamwork skill variable toward the conceptual knowledge of students (obtained significance of $0.037 < \alpha = 0.05$). This explains that the Group Investigation learning model is assisted by PhET and the teamwork skill is influencing the conceptual knowledge of the physics of the students because the learning can encourage the students to have teamwork skill in solving the problem on the subject matter so that the students better understand the concepts of physics thus will be achieved. The results desired by the teacher or student.

The ability of cooperation has a relationship to learning outcomes. Wiratana [22] put forward, "GI type cooperative learning model can train students to work together in groups to solve problems, so that later will improve knowledge and learning outcomes". This statement explains that with GI type cooperative learning model will produce student cooperation activity in learning environment and have relation to result of learning, so that good cooperation ability will have positive effect with result of student learning.

V. Conclusion

Based on the results of research conducted by using cooperative learning model type Investigation Group assisted PhET obtained the conclusion that students' conceptual knowledge using cooperative learning model type Group Investigation assisted PhET with average value 75.3 better than conventional learning with average value 69.0. The students' conceptual knowledge who have above average teamwork skill with 75.15 and higher categorization was better than students who have below average teamwork skill with a value of 69.53 and categorized high. There was an interaction between cooperative learning model type Group Investigation assisted PhET and conventional learning with a teamwork skill to the conceptual knowledge of physics students. In this research, the students' dominant conceptual knowledge on cooperative learning model type Group Investigation assisted PhET in the group of students who have above average teamwork skill

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